ER 10-8912/a



18 NOV 1958

Mr. Alan T. Waterman, Director
National Science Foundation
Washington 25, D. C.

Dear Alan:

Thank you very much for the publication "The Federal Research and Development Budget, Fiscal Years 1957, 1958, and 1959" which you were so thoughtful to send me.

I have looked it over and am bringing it to the attention of some of my associates for a further study. Should we need additional copies, my people here will get in touch with your office.

Once again, many thanks and kindest personal regards.

Sincerely,

Allen W. Dulles
Director

STAT

O/DCI/[redacted]:dd 17 Nov 58
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7 [illegible] 1958

Dr. Alan T. Waterman
Director
National Science Foundation
Washington 25, D. C.

Dear Dr. Waterman:

This Agency will be pleased to provide what information we have available as requested in your 27 June letter with regard to scientific research and manpower assets of selected foreign countries.

I have asked [redacted] Chief, Fundamental Science Division, Office of Scientific Intelligence, to work with representatives of the National Science Foundation. He will contact Mr. Mills, as suggested, to provide prompt support to your request.

Sincerely,

SIGNED

Allen W. Dulles
Director

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(EXECUTIVE REGISTRY FILE National Science Foundation

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OSI/FSD/[redacted]dgr (1 July 58)

ORIGINATED BY [redacted] 2 July 58
Deputy Chief, Fundamental Science Division/SI — Date

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CONCURRENCE: [redacted] 3 Jul 58
Acting Assistant Director/SI — Date

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CONCURRENCE: [redacted] 3 July
Deputy Director/Intelligence — Date

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Executive Registry
10-5047/1

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3 JUL 1958

BRIEF FOR: Director of Central Intelligence

SUBJECT : Acknowledgment of Request

1. This letter is an acknowledgment of the 27 June 1958 request of Dr. Waterman, National Science Foundation, for support of a NSF project to compare Western and Soviet Bloc Scientific research and manpower.

2. In accordance with the request it is recommended that [redacted] Chief of the Fundamental Science Division, OSI, will consult with Mr. Thomas J. Mills, Program Director, Scientific Manpower Program, NSF, to carry out this responsibility. [redacted] met with NSF personnel on this matter in March 1958.

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[redacted]

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Acting Assistant Director
Scientific Intelligence

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Approved For Release 2003/05/23 : CIA-RDP80B01676R001100030010-8

June 16, 1958

INFORMATION DESIRED BY NSF ON

FOREIGN COUNTRIES

Outline

I. Economic

A. Funds for scientific research and development

1. Fields covered (natural sciences and engineering, possibly social sciences)

2. Definition of r & d to include basic research, applied research, and development

3. Performance by group, such as Government, private, educational and other non-profit institutions

4. Sources of funds - private industry, educational and other non-profit institutions, and government

B. Scientific and technical manpower

1. Fields covered (engineering, natural and social sciences; technicians; college and high school teachers in these fields - See II)

2. Supply

(a) Type of employer such as Government, private, education

(b) Type of function

(c) Income

(d) Level of education and training

3. Demand

4. Utilization

II. Education (with particular reference to science and engineering.)

A. Background data on educational system; its character, scope, etc.

B. Training of scientists, engineers and technicians

C. Students

1. Enrollment

2. Attrition

3. Graduations

4. Post-graduation activities

D. Faculty (Secondary and higher education levels)

E. Physical plant

F. Finances

III. Institutional organization and factors affecting scientific manpower, education, and research

A. Legislation

B. Policy statements and administrative orders

C. Type of control and institutional framework (single-time reporting)

Next 8 Page(s) In Document Exempt

 [redacted]

ER 10-2144/1

SECRET

20 March 1958

MEMORANDUM FOR: DIRECTOR OF CENTRAL INTELLIGENCE

VIA : DEPUTY DIRECTOR (PLANS)

SUBJECT : Suggested Letter for Signature

REFERENCE : Letter to Director of Central Intelligence from Alan T. Waterman, Director, National Science Foundation dated 19 March 1958

1. This memorandum suggests action on the part of the Director of Central Intelligence. Such requested action is contained in paragraph 2.

2. Attached for your signature is a suggested letter acknowledging receipt of the correspondence from Alan T. Waterman, Director, National Science Foundation.

[redacted] 25X1

J. C. KING
Chief, Western Hemisphere Division

Attachment

cc: DDCI

SECRET

Next 13 Page(s) In Document Exempt

Approved For Release 2003/05/23 : CIA-RDP80B01676R001100030010-8

25X1

10-2144/1

SECRET

20 March 1958

MEMORANDUM FOR: DIRECTOR OF CENTRAL INTELLIGENCE

VIA : DEPUTY DIRECTOR (PLANS)

SUBJECT : Suggested Letter for Signature

REFERENCE : Letter to Director of Central Intelligence from Alan T. Waterman, Director, National Science Foundation dated 19 March 1958

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2. Attached for your signature is a suggested letter acknowledging receipt of the correspondence from Alan T. Waterman, Director, National Science Foundation.

J. C. KING
Chief, Western Hemisphere Division

Attachment

cc: DDCI

SECRET

STATEMENT BY ALAN T. WATERMAN
DIRECTOR, NATIONAL SCIENCE FOUNDATION

before the

EXECUTIVE AND LEGISLATIVE REORGANIZATION SUBCOMMITTEE
OF THE COMMITTEE ON GOVERNMENT OPERATIONS
HOUSE OF REPRESENTATIVES

January 15, 1958

Mr. Chairman, Members of the Subcommittee: Events of recent months have brought into sharp focus research and development activities in the United States, as well as the education and training of our young people, particularly in science and technology. It is therefore most timely that this Committee should undertake a thorough review of Federal responsibilities in those areas with a view to improving the situation wherever there seems to be a need. I am happy to appear before you this afternoon and to place in perspective, if I can, the objectives and operations of the Federal Government in supporting and fostering scientific research and development and education in the sciences.

1. The relative place of the United States historically and currently in the world of scientific thought, activity and development.

The half century just past has witnessed the phenomenal rise of American technological development to the point where the United States occupied the position of unquestioned leadership. The growth of the United States as a great industrial democracy began at about the time that new sources

of power began to be cheap and widely available. It was an American, Eli Whitney, who is better known for his invention of the cotton gin, who also invented the principle of interchangeable parts and thus helped to lay the groundwork for an era of great industrial expansion based on the growing capacity for mass production. The history of this period also witnessed the rise of a number of great industrial firms, such as General Electric, Dupont, Western Electric, Westinghouse, and others. It was firms such as these, whose future depended on new advances in technology, that marked the beginning of large-scale industrial research in this country. The inventive genius of such individuals as Bell, Edison, Morse, Whitney, and others laid the groundwork, but it was obvious that in order to maintain their own in the face of keen competition, each company would have to seek constant new refinements and innovations. Since World War I, the United States has led the world in applied research and technology. In fact, we have come to take that leadership so much for granted that the recent evidence of serious challenge to U.S. supremacy from the U.S.S.R. has come as a rude shock to most Americans and has brought about a period of intensely critical self-examination and analysis.

The more scholarly type of scientific research into the secrets of nature that we describe as basic or fundamental research developed less rapidly in the United States. Although the early history of science in the United States is distinguished by such brilliant names as Benjamin

Franklin, Joseph Henry, and Willard Gibbs, the United States was largely preoccupied with the problems of an expanding frontier economy. We turned to Europe for our basic knowledge and then applied it with brilliant success.

Our own development in pure science may be said to have begun in the 1920's and has grown rapidly ever since. Whereas a few decades ago science students flocked to Europe to get their training, in more recent years the trend has been reversed. Some indication of relative standing in quality of research among the nations is to be found in the number of Nobel Prize winners. Although the number of Nobel Prizes in science awarded to the United States was low during the early part of the century, it has increased greatly in the last two decades. However, we may not have done so well as other countries in relation to total population. Germany, before 1933, had probably achieved a research strength relative to its population which we have not yet reached. Of the large nations, the United Kingdom has been, and probably still is, at the top in numbers of distinguished scientists and quality of research in relation to population and income. One might add, also, that on a relative basis, small nations like the Scandinavian countries, the Netherlands and Belgium have done extremely well.

As for the U.S.S.R., the evidence increasingly shows that as a result of the concentrated efforts of the last few decades, the U.S.S.R. is producing numbers of competent scientists which constitutes a maximum in terms of their

total potential. This is an imposing fact. Whether by this means they can succeed in their expressed ambition to dominate the world in scientific and technological achievement remains to be seen. At present they are not considered to have clear leadership in any field of basic research, except in Arctic research and in certain areas of geophysics. They are excellent in mathematics, astronomy, and theoretical physics, for example, and quite weak in biology. However, they are providing their scientists with modern research facilities at a rate that will be hard for us to match, even if we put forth a strong effort, which incidentally we have not yet done. In all fields they have high respect for scholarly work, whether applicable or not.

The moral to be drawn from all this is that the relative strength in fundamental research of the European countries is the result of their genuine respect for learning, for teaching, and for fundamental research--an attitude which we as a people have never had to the same degree.

2. A summary of the relative positions of the United States, the Free World and the Communist World with respect to scientific education and manpower.

Let me begin by saying that it is dangerous to assume that any single country or group of countries enjoy a natural superiority over others in the matter of brains and intellectual capacity. All the evidence points to equal intellectual ability on the part of all nations, particularly those that

have developed traditions of education. This category would include, for example, in addition to the Western World, India, Japan, and China. It follows then that the potential scientific manpower available in the countries of the world is probably the same relative proportion of the population in each. Therefore, the only advantages in technology enjoyed by any nation lie in the strength and breadth of the general education system, the degree of development of aptitudes among the people for science and engineering (as well as in other fields), industrial experience and know-how, and last but not least, the interest and the determination of the people to develop scientific manpower and scientific activities.

At the present time, the U.S. lags behind most other countries--certainly all of the leading countries--in the understanding, respect, and prestige accorded learning in general and science in particular. The U.S.S.R., on the other hand, has demonstrated great singleness of purpose and has evolved the most effective procedures for concentrating upon the education and development of scientists and engineers. It has also solved the problem of providing scientists and engineers where needed, either for research or for teaching.

In the recent report by Senator Henry M. Jackson, "Trained Manpower for Freedom," he observes that "Scientific manpower is being graduated in the Soviet Union at a present per capita rate approximately twice that of the NATO community as a whole. Russia now turns out more scientifically trained people than

any western nation and is accelerating the output at a higher rate than any nation. Furthermore, Soviet instruction is of high quality."

The weakness of the Soviet system lies in the probable incompatibility of developing free research to the utmost under a totalitarian system. Furthermore, it is questionable whether under the training given in a totalitarian system scientists and engineers can acquire the same breadth of view and insight which come with a free system. However, whether these weaknesses constitute a serious threat to the continued advance of the Soviet Union remains to be seen. In any event, in the short term their system must be regarded as formidable, and it should be clear that the only advantage which the United States can hope to achieve depends upon the quality of performance. This in turn depends upon the kind of cooperation and broad know-how that come only from well rounded tradition and experience. We are now realizing that the breadth we have is not enough unless it includes a full complement of top-notch, highly trained and imaginative specialists. Among the latter, scientists and engineers of the highest quality and in requisite numbers are indispensable.

3. Scientific fields in which the United States has lagged and in which it has forged ahead, and the effect of the activities and policies of the Federal Government in such cases.

In general, the United States has made the most notable progress in the fields of research that underlie the principal

technical industries. Such fields include electronics, solid-state physics, high polymer chemistry, biochemistry, nuclear physics, computer design and technique, a number of fields of biology, agricultural research, low-temperature physics, applications of nuclear energy, and certain types of space research involving rockets and balloons. We have lagged most conspicuously in the earth sciences, a category of research that includes such important fields as meteorology, oceanography, geophysics, certain fields of geology, and now the opportunity for satellite research of outer space.

United States facilities for research and development are in many respects outstanding. Both industrial and Government laboratory equipment, test stations, and other installations have been models for the rest of the world. By contrast, college and university laboratories have been showing great need of renovation, new construction, and modern equipment. Scientists returning from the U.S.S.R. report that great effort is being expended on laboratories and instruments; and even in the case of such costly equipment as high-energy accelerators, no expense is being spared to make them as efficient and advanced as possible.

## Effect of activities and policies of the Federal Government.

Generally speaking, with the exception of agriculture, it is only since World War II that Federal policies and activities in support of science have begun to be felt in a national way. Prior to that time, Government participation

in, and support of, scientific research and development was on a relatively small scale. Excellent results were produced by such agencies as the National Advisory Committee for Aeronautics, established in 1915, which conducted an outstanding program in aerodynamics; certain branches and departments of War and Navy Departments were producing valuable results in their laboratories; and, of course, such scientific activities as agricultural research, Public Health research, and the National Bureau of Standards were of long and honorable standing within the Government establishment. But it was the full impact of science and technology upon military weapons and strategy during World War II that brought not only expansion of the Government's research and development activities in its own laboratories, but introduced the widespread use of the research and development contract as a device for securing needed results in a minimum of time. Under the auspices of the Office of Scientific Research and Development, the Government contracted for research on a wide variety of problems ranging all the way from the development of DDT and penicillin to the research that led to the first atomic bomb. A major feature of the war effort was the major role played by the colleges and universities in carrying on research and development under Government contract.

The effects of Government policies and practices in support of research during the war were obviously good. Not only were the major weapons and devices that played a crucial role in the war produced under this system, but support was

also given to a certain amount of fundamental research, and the effects were found to be desirable. The continuation of Federal support for research and development by contract and by grant by such agencies as the Department of Defense, Atomic Energy Commission, Department of H.E.W., and others has produced excellent results for the Government. Nevertheless, there is a growing concern lest the extent of the Federal research and development program encroach upon the universities' normal functions of teaching and research.

It has become apparent that the universities are depending more and more upon such contracts and grants to support the research of regular departments of the universities, particularly in the fields of the physical sciences. This situation is partly the result of the Federal Government's cautious support of basic research as contrasted with the heavy support for applied research, development, and engineering. Although the basic research programs of such agencies as the Office of Naval Research, National Institutes of Health, Atomic Energy Commission, the National Science Foundation, and other agencies have won the respect of the scientific community, there is general agreement that the total effort has been far too small. For example, since the establishment of the National Science Foundation in 1950, requests for assistance to the Foundation alone have exceeded the funds available by four or five times, and the Foundation could have supported about three times as many meritorious applications as it has been able to support with the funds available.

Although up to now the Federal Government has provided significant support for wind tunnels, computer development, nuclear reactors, and accelerators, the lack of Federal funds for radio and optical telescopes, and oceanographic vessels, has been a contributory factor in the lag of the United States in these fields. In oceanography, for example, it is well known that the Soviet Union has in service several major research vessels constructed and equipped for oceanographic research and operated under the direction of scientists. The United States has no comparable vessels of its own, and the two or three ships being used for this purpose are reconstituted vessels, entirely inadequate to the need; in fact, one of the principal vessels in use looks as though it were left over from a whaling fleet.

4. The proper place of Government in scientific research and development. Is Government support necessary if the United States is to keep pace in the world of science?

It is becoming increasingly clear that a major responsibility of the Federal Government with respect to science is to see that both research and education in the sciences receives support, encouragement, and all necessary measures to maintain the scientific and technological power of the United States. A second responsibility is the adequate support of research and development necessary to the missions and specialized programs of the respective Federal agencies.

In general, research and development in support of agency

missions has received the major share of the Federal Government's interest and support. In the Department of Defense and defense-related agencies particularly, the objectives of such research are readily identifiable and have been given priority of attention.

Until recently, the advancement of science generally and the effective training of our scientists and engineers has not been viewed as a major area of concern for the Federal Government. It is becoming increasingly clear, however, that we are in a race for technological supremacy and that our very survival may depend upon the high quality of our scientific effort. It is now beginning to be understood that the maintenance of technological pre-eminence depends fundamentally upon two important factors: full support of basic, long-term research, even though its ultimate application cannot be predicted, and the training of high-caliber students in science and technology in sufficient numbers to meet the needs. The time element is now so crucial that we can now no longer leave to chance the possibility that gifted students with aptitudes for science and technology will be identified, motivated toward those fields, and educated up to their highest skills. The upsurge in student population which will overwhelm our colleges and universities in the next decade will take so much attention, money, and effort that the problem of special attention to the gifted becomes a matter of major national concern.

It is obvious from relative population figures that

the United States is outnumbered, and will continue to be outnumbered, by the Soviet Union. If we are to hold our own, therefore, we have no choice but to concentrate on quality. This means that there must be a radical change in our national attitude toward learning and toward teaching. The Federal Government must assume responsibility for what cannot be done on a local basis, or cannot be done in time, in order to insure the high quality of teaching in all the fields of science, and to insure, also, that every needed step is taken to seek out and educate the gifted in all fields, and particularly in the technical fields where the training is longer and more exacting than in some others.

5. Major area of deficiency in Federal expenditures in fields of scientific research and development.

By all odds, the major area of deficiency in Federal Government expenditure for research and development at this time lies in the inadequate support of basic research and the facilities and equipment needed for basic research, especially by colleges and universities. According to the most recent issue of the Foundation's annual study, Federal Funds for Science, "More than 60 cents of every dollar for research and development is obligated for development; less than 40 cents for research, both basic and applied; and approximately 8 cents of the latter goes into basic research. In fiscal year 1957, total obligations for development amounted to $1.7 billion; for research, $964 million, of which $218 million was

obligated for basic research."

As I mentioned earlier, an important factor in the support of basic research is the increasing size, complexity, and consequent cost of equipment and facilities needed for basic research. Although such major items as high-energy accelerators, nuclear reactors, and electronic computers have generally been provided by the Government for work to be done under contract, such equipment has been far less available to the universities for their own research programs and for the important function of training young scientists in the special techniques required by such modern instruments. The costs of such equipment run into the millions and hence are beyond the resources of most universities, or even groups of universities. Nevertheless, a number of universities have displayed a strong desire to acquire such instruments by supplementing Federal monies and by pooling resources so that a major facility could be made available to all the universities within a given locality.

The Federal Government must be prepared to expand its support of the types of facilities mentioned, and to extend such support to include oceanographic vessels and special laboratories and field stations in polar, tropical, marine, and arid environments. The lack of such equipment and facilities in the very basic fields of the earth sciences is one reason why United States research tends to lag behind that of other countries in those fields.

At this particular time, attention centers in the area

where the United States conspicuously lags and that is the field of space technology. Although we have actively and brilliantly pursued upper-atmosphere research by means of high-altitude balloons, rockets, and combinations of the two, our satellite program has not yet materialized. The capabilities of the Soviets, as demonstrated by their performance in successfully launching two earth-circling satellites, opens up whole new vistas for the future of space research and technology. Only a determined effort on our part, properly organized, with adequate funds, facilities, and competent manpower, can close this gap.

It would be a mistake to regard space research as primarily a military problem or to pace its progress with that of the missiles program. The earth satellite is a powerful new scientific instrument, capable at present of providing much needed data about the outer atmosphere and about the character of the earth and its environment as viewed from outside. From an instrumented earth satellite to a research observation platform in space is but one additional step. The scientific data that these instruments can furnish will provide much of the knowledge needed to determine whether space travel is feasible or valuable. The new knowledge to be gained through research with satellites and space rockets may have practical consequences of the same magnitude as those based on nuclear research.

6. The efficiency and economy of the organizational structure through which the Federal Government plans and conducts its research and development activities, including a description, the agencies which are involved, and the major relationships among them.

The organization, planning, and conduct of research and development by the Federal Government is a large and complex problem, requiring continual examination and review in the interest of balance, adequacy, and coordination. Part of the problem stems from the size of the operation. The estimated level of Federal expenditures for research and development in fiscal year 1957 was $2.8 billion, an amount far in excess of any comparable effort by private industry. Another part of the problem stems from the wide diversity in the scientific activities being supported by the various agencies of the Federal Government. Some 23 departments, offices, agencies, and establishments of the Executive Branch of the Federal Government administer funds for scientific research and development. In fiscal year 1957, the Department of Defense and the Atomic Energy Commission together accounted for 85 per cent of the total funds. Other agencies with substantial research and development programs include the Department of Health, Education, and Welfare, Department of Agriculture, National Advisory Committee for Aeronautics, Department of the Interior, Department of Commerce, and National Science Foundation. The other 15 agencies account for the remaining one per cent of the total obligations.

The major programs of the agencies enumerated evolved

over different periods of time, with differing objectives and procedures. It is therefore difficult, if not impossible, to apply a common yardstick against which the programs of all the agencies could be rated in all respects in terms of efficiency and economy. For example, the problems of administering an agricultural research program, through the state experiment stations, or administering a grants program for basic research in the colleges and universities, are so different from the problems of administering an intercontinental ballistic missile program that it is quite impracticable to attempt a comparison except in the very broadest terms. By the same token, the establishment of a single department of science and technology, far from providing a solution to the innumerable and widely differing problems inherent in the over-all Federal research and development program, would create additional problems.

Despite the differences in the various governmental research and development programs, however, there is good coordination and understanding among them. One thing that all research and development programs have in common is scientists; and scientists are thoroughly accustomed to working cooperatively and to keeping themselves informed of what is going on in their own and in related fields. Failure to do so is to commit professional suicide. Except where security provisions are involved, scientists exchange information on their work in the Government as they do on the outside; they publish in the same journals; they attend the same meetings.

In addition, other measures designed to bring about a more formal exchange of information have been instituted. The Interdepartmental Committee on Scientific Research and Development, consisting of the directors of research in all the agencies with major scientific research and development programs, affords a forum for consideration of common problems such as administration, personnel and scientific information exchange.

The research and development activities of the Department of Defense and the National Advisory Committee for Aeronautics are closely coordinated in order to avoid undesirable overlap in their developmental activity. Similar coordination is effected among the National Institutes of Health, the Atomic Energy Commission, and the Department of Defense in the fields of medical research.

The Foundation maintains a central register of basic research projects being supported with Federal funds, outside the Federal Government itself, in the life sciences, social sciences, and the mathematical, physical and engineering sciences. These records are compiled and published at regular intervals so that each agency may have the opportunity to review what is being done by other agencies in the same field.

Those agencies that are supporting basic research maintain informal working relationships with other agencies so that action by one agency on an application for support is

promptly known by others in the same field.

The functions of all the agencies that conduct or support scientific research and development are too extensive and too detailed to be outlined here. The National Science Foundation has compiled a directory of these, entitled Organization of the Federal Government for Scientific Activities. This document covers 347 pages and is accompanied by organization charts and general descriptions of the scientific activities of all the agencies involved. It will no doubt come as a surprise to many Americans to realize that the Federal research and development effort is so extensive and diversified.

In stressing the scope and diversity of the Federal research and development program, I should not wish, however, to create the impression that there are no common problems or procedures, and especially that there is not room for improvement in these. Certainly, there are many such areas that would repay careful examination and attention.

One procedure that all agencies have in common is the budget process. Speaking as one who is not an expert in the comparative practices of the several nations, I may nevertheless venture a few remarks comparing the United States with other systems. In this country, each department and agency of the Executive Branch, after much study and planning by all units involved, presents its proposed budget for the coming fiscal year to the Bureau of the Budget for thorough examination and review, both in terms of its relation to the

requesting agency and to the President's over-all budget. After the agencies' budgets receive the approval of the Bureau of the Budget on behalf of the President, they are defended by the agencies before the two houses of Congress and are thus subject once again to careful examination and review. The entire process engages the attention of a significant portion of each agency staff for a period of about a year and a half for each budget. This system is probably more thorough than that of other large governments. It is also probably the most protracted. Its chief drawback is the time lag between the initiation of plans and the receipt of funds for carrying them out. Under most other systems, as I understand it, the budget is prepared by the department in consultation with the government, and the whole process is accomplished in one step. The government's budget is not a matter for review and debate in such a system, unless indeed the government is challenged and falls.

Although we do not know the details of the Soviet system, some idea of its effectiveness with respect to matters of high priority may be inferred from a conversation between the head of the Russian high energy nuclear accelerator project and one of our nuclear scientists attending the International Conference on "Atoms for Peace." When the Soviet scientist was asked what arrangements were made for the money to carry on his work, he replied that he and his group were not involved in fiscal matters but had merely to state their needs and construction of the accelerator began at once. Other

American scientists returning from meetings in Moscow report that Soviet scientists appeared to be under no obligation to economize, as the Russian equipment was constructed of the finest material available and quite obviously no expense had been spared. Under this system, research projects that enjoy a high priority would be expected to get under way a year earlier than would otherwise be the case.

The whole budgetary process is a matter of particular importance and concern for basic research in science because such research involves the exploration of the unknown. Projects in this area cannot be clearly justified in terms of the specific promise of results. Obviously, no one can foresee before the research begins what the results will be or how significant they may ultimately become. Therefore, funding for this type of research is subject to a very considerable handicap in competition with funds for specific practical purposes, the nature of which is well understood.

Because of the nature of the budgetary and appropriations processes, it is difficult to make funds available for the prompt support of sudden, unexpected developments whose pursuit seems indicated in the national interest. In view of the rapid pace of modern science and technology, eighteen months or two years could well prove too long a period in which to wait before moving into a given area. It would be advantageous to have some sound way of dealing with this problem. Likewise, it may be pointed out that basic research requires continuity and stability of support, otherwise

valuable momentum and key personnel are lost.

7. The relative efficiency and economy involved in conducting scientific research and development through Government facilities, universities, other nonprofit organizations and private contractors.

In attempting to evaluate the relative efficiency and economy of the various methods by which scientific research and development is conducted under Government auspices, one must first of all understand something of the circumstances under which each method is used. The rapid growth of research and development needs by the Federal Government in the period following World War II has resulted in a changing pattern by which such research is accomplished. As I mentioned previously, prior to World War II, most Federally-supported research and development was performed in Government laboratories by Government personnel. Notable examples were the military laboratories, the public health laboratories, the laboratories maintained by the NACA, including subsonic and supersonic wind tunnels, and the scientific establishments of the Department of Agriculture, the National Bureau of Standards, U. S. Weather Bureau, and the Bureau of Mines. During World War II, when there was clearly no time to expand existing laboratories or to construct new ones under Government auspices to meet the emergency, the research and development contract came into widespread use. This type of contract was awarded both to industrial concerns and to colleges, universities, and nonprofit research institutes. This device

proved so successful during the war that its use was continued and extended in the postwar period.

Coinciding with the growth of the research and development contractual procedure was the gradual evolution of the research center and the national laboratory. This type of institution came into being originally because several of the universities operating under large-scale research and development contracts felt it necessary to segregate Government work for reasons of security, and also because staffing and administration problems differed markedly from those normally employed by the university in the conduct of its own affairs. Such laboratories included the Radiation Laboratory at MIT, the Applied Physics Laboratory of Johns Hopkins University, the Allegheny Ballistics Laboratory of the George Washington University, the Los Alamos Scientific Laboratory, administered by the University of California, and the Argonne National Laboratory, administered by the University of Chicago.

The national laboratories have achieved outstanding success. In some cases special associations of universities have been formed for their management, as for example, Associated Universities, Inc., for the Brookhaven Laboratory and for the National Radio Astronomy Observatory, and the Associated Universities for Research in Astronomy (for the establishment and operation of a new national astronomical observatory in the Southwest).

With these several methods available for the performance of needed research and development, the Government departments

with R&D programs have a choice as to which method shall be used. There are advantages and disadvantages inherent in each.

Generally speaking, the Government-owned and operated laboratory has the advantage of permanence and closer incorporation within the Federal structure, which are associated with a continuing need in fields of research and development for which there is no commercial interest and which may be unsuitable for an academic environment.

The research and development contract is widely used for large and small projects. Its advantages are clearly the speed with which action can be taken to proceed with research and development along lines with which the contractor has available high competence and experience.

The national laboratory has the advantage of general access to competent research personnel, especially from colleges and universities.

The research center, when established in conjunction with an academic institution, is in an environment where the broad background and experience of the academic faculty of the institution may be brought to bear in a convenient consulting manner, as well as high competence in the direction of research projects. Historically, several of the Research Centers developed out of an existing nucleus of talent, as was the case with the Radiation Laboratory at MIT. The Los Alamos Scientific Laboratory originated in the special facilities of the University of California physics department, which had on its faculty, among others, Ernest Lawrence and J. Robert

Oppenheimer. Project Lincoln was placed at MIT, where high competence in management of research and development existed and where there were also excellent facilities for engineering and electronic research and high-speed computation for background.

Where speed and flexibility have been prime considerations, it has been natural for the Federal departments and agencies to contract for an existing Research Center rather than to expand or to develop new laboratories of their own. This has been particularly true in the case of the newer departments--the Atomic Energy Commission, created in 1946, and the Air Force, in 1947.

One may not generalize and state categorically that any one of the foregoing methods is more efficient or more economical than the other; for if sound judgment is used, we may assume that the method chosen is probably the best in a given situation. We must recognize that the pattern of Federal research and development activities is a highly dynamic one, and that even as new challenges and new problems arise, so, too, we must be prepared to evolve new devices and techniques for meeting them.

Before leaving the subject, however, I should mention that the wide differences in personnel and administrative procedures employed by the Federal Government, private industry,

and academic institutions are a complicating factor that necessarily influences the choice of method. Government establishments unquestionably suffer from the fact that the ceiling on the salaries available to scientists and engineers is markedly lower than salaries for comparable work in private industry. This fact makes it difficult for the Government to recruit and hold in its own laboratories the scientists and engineers it needs.

Colleges and universities labor under personnel difficulties similar to those of the Federal Government as an employer, and sometimes in the smaller institutions the situation is acute. However, the salary problem is offset to some extent by the freedom for research, which is greater than in industry or government, and the added attraction of research that is associated with teaching. A recent study by FORTUNE shows that a preponderance of brilliant young American scientists prefer the universities to industry because of the greater

appeal of academic life.

Nevertheless, effort should be made to establish better equilibrium in the salaries for scientists and engineers, in order that the Government may be able to acquire the staff that it needs, and in order that universities may not be raided of their teachers and high quality scientists.

The foregoing discussion relates primarily to the type of research and development for which the Government itself has a definite need. In all such cases, the Government presumably takes the initiative in seeking out the method best suited to the problem at hand. An entirely different set of considerations apply to the support of basic research where the Government's interest is the increase of knowledge rather than the solution of a specific problem. The experience of departments and agencies supporting that type of research has been that the research grant offers the most satisfactory instrument for the purpose. In fact, many features of the research grant have worked out so satisfactorily in practice that the National Science Foundation has been moved to recommend that some of these, notably the provisions with respect to the accountability for property, be substituted for less workable provisions in the research contract.

8. Any suggestions regarding actions Congress or the Executive agencies can take to facilitate and stimulate scientific research and development in the United States and in the Free World, or to remove impediments thereto.

My suggestions as to what the Congress and the Executive agencies can do to facilitate and stimulate scientific research and development in the United States and the Free World would be, in effect, a summarization of what I have attempted to say here today. Let me say at the outset, also, that whatever the Congress and the Executive agencies attempt to do along these lines can only be effective if there is an informed body of public opinion throughout the United States that recognizes the nature of the problem, its importance, and the necessity for remedial action. Our people must realize that they have a right to look to the Federal Government for leadership in attacking many of these problems, but that they, too, have a responsibility for meeting the problem, wherever possible, at community and state levels.

As I have tried to bring out in my testimony today, Government action is needed in the following three broad categories:

(1) Education: There must be close and continuing cooperation between local, state, and Federal Government to strengthen and improve education in all fields, so that our country may have all the well-trained people needed for all aspects of national life. There must be a concerted effort to improve the quality of teaching in scientific and technical fields at all levels, but particularly at the secondary-school level where today many people are teaching these subjects without adequate preparation. There must be an organized effort to identify and motivate youngsters with special

aptitudes for science and technology. Where financial support is a problem, aid should be provided.

(2) Basic Research: The nature of, and the necessity for, basic research is imperfectly understood by the vast majority of people, and this has made it difficult to secure adequate funds for its proper support and encouragement. The most important single action the Executive Branch and the Congress can take to stimulate scientific research and development in the United States is to provide adequate support for competent research scientists, in accordance with the needs of the country, in such major areas as defense, and health and welfare, and above all, to provide encouragement and funds to competent scientists in basic research wherever found. Only in this way can the United States make satisfactory progress in fundamental science, which is the basis for all future development.

(3) Basic Research Facilities: Facilities and equipment for basic research, particularly capital facilities, are urgently needed to advance the frontiers of science in many important fields of research. The capital facilities are national needs and only a few of each are required. However, they are increasingly costly, and the consequent tendency to postpone appropriations should be avoided. In this category are included such items as high-energy nuclear accelerators, nuclear reactors, wind tunnels, testing basins, oceanographic research vessels, high-speed computers, optical and radio telescopes, large facilities for basic research in meteorology--

such as aircraft and radar--and the facilities required for high-altitude research--balloons, rockets, and satellites. Fortunately, not all fields of research require such costly items as these; but unless the country is prepared to underwrite the costs of those that are needed, its progress in science will suffer materially, since the areas of science they represent are among the most promising for the future.

At this point it may well be asked: Why do we feel justified in urging support of all competent scientific research? Will this not lead to an impossible economic situation, since obviously we do not have funds, manpower, or facilities to carry out all the promising ideas generated by the scientists? It is true, of course, that the security of a country depends not only upon its progress in science and technology but upon many other factors, chief of which is the strength of its economy. The latter, in turn, depend upon many factors, including, of course, the proper balance among its activities. Are we then in a dilemma? If we make the maximum effort in research and development, do we jeopardize our economy and therefore our security? On the other hand, if we withhold adequate support to research and development, we may help to balance the budget but jeopardize our security by failing to maintain technological supremacy.

The answer, I believe, is clear. We should encourage and support basic research to the limits of the capabilities of our scientists and engineers. By so doing, we make available to ourselves the full potentialities of all new

discoveries of science. We should then give careful consideration to which of those potentialities we should emphasize and support for development and ultimate production. This is one of the best ways to control the National budget. In this way we should be able to maintain a sound economy and at the same time achieve our highest priority goals. To support basic research fully requires relatively modest amounts of money, except for capital facilities. It is in the other stages of technology--applied research, development and production--that the large costs occur. Therefore, we are not jeopardizing the national economy in providing full support for basic research. In fact, I must go further and declare emphatically that unless basic research is adequately supported, we are certain to miss opportunities for development and application that may mean all the difference between success or failure in the race before us, whether for war or peace.

Fortunately, there are modern processes of analyzing the findings of science which help in selecting those that promise the most fruitful application. Two modern techniques--systems engineering and operations research--can give invaluable assistance at this stage, as they are now doing, but they can be developed more fully.

Systems engineering or systems analysis is well understood by the technical industries, which have developed it to a high degree. It consists of a detailed layout of the steps required to undertake a given development--its

possible directions, its bottlenecks, its time schedule, etc. A thorough-going analysis of this kind should determine whether a development is currently feasible or whether it should be postponed for future research, the general form and direction the development should take, possible bottlenecks, time schedule, and degree of feasibility.

Operations research consists in an analysis by special techniques of a scientific nature that were developed during the war and postwar period. Using the mathematical bases of probability and other scientific devices, operations research can predict the degree of success of a given development and especially a comparison of the effects of the new development upon operations as compared with current or older plans.

These techniques do not in themselves provide complete answers as to the wisdom of embarking on a given undertaking. However, they do provide powerful assistance to management in making its decisions by furnishing as complete data as possible concerning the feasibility, time schedule, and degree of success of the venture.

It is after we have passed the stages of basic research and selection of items for development and enter the prototype stages that the costs begin to assume truly large proportions. Here again, technology is able to effect substantial savings. The high-speed electronic computer is able to do "research on research" in the sense that it can evaluate the performance of proposed alternative types of designs, and even of alternative weapons or weapons systems, thus

obviating the need for the construction of expensive prototypes. Literally thousands of variations on an air frame, for example, can be computed as to flight characteristics. Only those variations that meet specified performance characteristics need be developed.

A computing machine can be programmed so that the characteristics resulting from an initially-assumed design are calculated. The calculated performance is then automatically compared with what is desired and the initial design modified so as to produce better agreement. This process can be rapidly repeated until a design is reached which should give a fair indication of performance to meet the specifications. The whole process is carried by the computing program in the machine without human intervention.

Full support of basic research, far from being incompatible with a balanced budget and a sound national economy, is absolutely essential if properly understood and wisely pursued.

In conclusion, I wish to say that I have not overlooked the reference to the Free World as well as the United States in the last topic that you asked me to discuss. To some extent the remedies with which we seek to repair and strengthen our own position in science and science education are equally applicable to all the Free World. Obviously, such objectives must be carried out with a unity of purpose and in a wholehearted spirit of cooperation that transcends national interests in the narrower sense. Most important,

in my opinion, is taking steps to strengthen and extend scientific collaboration between the United States and other countries. This includes the removal of impediments to the exchange of scientists and scientific information. As the President said the other day, "the task ahead will be hard enough without handicaps of our own making."

A recent significant step was the action of NATO in announcing the establishment of a Science Committee on which, in the words of the official communique, "all of the NATO countries will be represented by men highly qualified to speak authoritatively on scientific policy. In addition, a scientist of outstanding qualifications will be appointed as Science Adviser to the Secretary General of NATO." This is indeed an important move forward, and our Government can do a great deal to insure its success by supporting the participation of the United States in the science program for NATO which the Committee is expected to formulate.

-- 30 --

MEMORANDUM FOR: MR. DULLES

You asked for the full text of Alan Waterman's statement before the House Committee on Government Operations.

Attached also is a letter to Chairman Moss from General Cabell (TAB A) which deals with Moss' inquiry concerning the exploitation and procurement of Russian scientific literature.

25X1

22 Jan
(DATE)

FORM NO. 101 REPLACES FORM 10-101
1 AUG 54 WHICH MAY BE USED. (47)

MEMORANDUM FOR: GENERAL CABELL

CR

The attached came in while you were away. The Director wanted to be sure that you agree with the action taken, i.e., his approval and signature.

[redacted] 25X1

5 Apr 58
(DATE)

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CENTRAL INTELLIGENCE AGENCY

# OFFICIAL ROUTING SLIP

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**Remarks:**

Per my conversation with [redacted] will you please prepare an appropriate coordinated reply for DCI signature.

In addition DCI would like to see a brief report of the type of assistance [redacted]

Suspense 27 March 58

FOLD HERE TO RETURN TO SENDER

| FROM: NAME, ADDRESS AND PHONE NO. | DATE |
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| [redacted] Assistant to the DCI | 24 Mar 58 |

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| TRANSMITTAL SLIP | DATE JUL 3 1958 | |
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REMARKS: The original of this along with a reply for DCI signature went to O/DCI on 3 July. This didn't get with it. Sorry.

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